AGRICULTURAL Research

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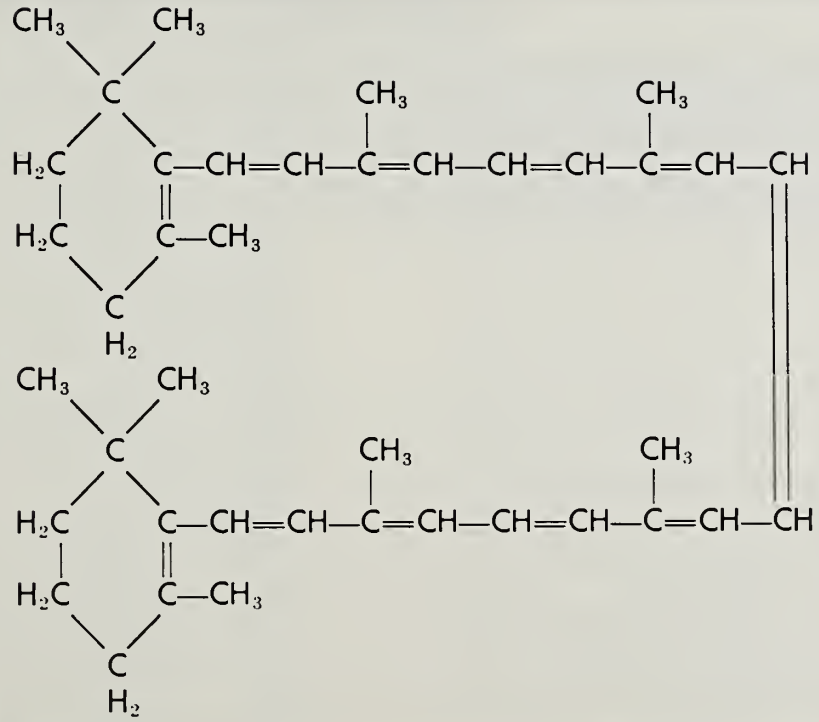

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Too Vital a Word

The word *ecology* bombards us daily, yet it is a maddening paradox that as the word gains wider currency its meaning is being largely lost. For example, we read and hear about the "ecology" of soaps, foods, planned communities, scenic vistas, conservation programs—to cite only a few recent usages. There is cause for concern when we lose accuracy in a tool of thought and expression.

Ecology stems from the Greek word *oikos,* meaning household. It was first used by Ernst Heinrich Haeckel (1835–1919) to describe the harmonious association and orderly succession of plants and animals in response to the conditions imposed by a given soil and climate. Thus ecology is not a thing, nor does it equate with conservation or environment. Ecology is an effort, partly intuitive, to draw together the various disciplines of science and replace fragmentation and compartmentalization with wholeness—a proper approach in studying the unity of nature.

A basic tenet of ecology is that all living things—from bacteria to man—fit into a web of life governed by dependence upon one another and their environment. So incredibly interwoven are the countless threads of this web that in tracing disruptions it is difficult to determine what is cause and what is effect. Unfortunately, this ecological fact of life has often gone unheeded as we manipulate the environment in our daily activities. The American penchant for solving problems on an individual basis is a worthwhile attribute only as long as we remember that man is a part of, and not apart from nature. For whatever we put into or take away from our lands, waters, and airsheds will sooner or later affect us all. This is what ecologists mean when they refer to the ecological whole, or in technical language, the ecosystem.

There are aspects of mind and spirit to ecology that can transcend one's knowledge of the word's dictionary meaning. These aspects can not only encourage the study of and a respect for the interaction of living beings with one another and their surroundings, but can also foster an awareness of the dependent alliance that binds man to everything, even that which is most distant and most different. An awareness of these vast and often imperceptible linkages is an important step to a "kind of vision across boundaries" as one ecologist put it. In these times of widespread concern about environmental degradation, *ecology* is too vital a word to be tossed about casually and meaninglessly. It is worthy of respect and precision.

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COVER: Chemical structure of *B*-Carotene (Provitamin A). The best sources of Vitamin A are cod-liver oil and other fish liver oils, livers of other animals, butter, and eggs. The provitamin occurs most abundantly in carrots and other yellow vegetables such as squash and sweet potatoes, and many green vegetables—particularly broccoli, spinach, and beet greens. See story on page 3.

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U.S. Department of Agriculture

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Vitamin A: how much?

HOW MUCH is too much vitamin A? How much is too little? What are the factors that affect human vitamin A requirements?

According to a recent ARS study—one of a series designed to help establish priorities in planning human nutrition research—further controlled studies are needed to answer these questions.

Although vitamin A has been recognized as an essential nutrient for more than 50 years, ARS nutritionists Mildred Rodriguez and Isabel Irwin, Beltsville, Md., in their search of the world literature for published reports on the human dietary requirements of different population groups, found little evidence of basic research on the amount of vitamin A required by man.

Vitamin A comes in two forms: (1) preformed, called "retinol" and (2) retinol precursors, called "provitamin A." Retinol, found in animal tissues and products, is ready for the body to use, but the provitamin A compounds, found in green and yellow fruits and vegetables, must be changed to retinol within the body before they can be utilized. The average American diet contains both retinol and provitamin A. In developing countries, the pro-

vitamins are the principal dietary source of this vitamin.

Scientists have found that 10 of the provitamin compounds can be converted into retinol by the laboratory rat, with some compounds yielding more retinol than others. In man, only one provitamin A compound (beta-carotene, the pigment found in yellow and green plants) has been studied. The body is able to store large amounts of retinol in the liver for future use—one of the reasons nutritionists advise that liver be eaten frequently.

Two methods have been used for estimating human vitamin A requirements—field surveys and controlled dietary studies. The problem with field surveys is that pure vitamin A deficiency is seldom found alone. When vitamin A is lacking, the diet is usually low in other nutrients as well.

The ARS nutritionists found that most of the controlled studies on human dietary vitamin A requirements were carried out in the late 1930's and 1940's. In these studies, the adequacy of vitamin A in the diet was measured by the ability of the eyes to adapt to the dark and by the concentration of vitamin A in blood plasma. The retina of the eye contains a pigment, visual purple, which is composed of vitamin A and protein. Without sufficient vitamin A, vision in dim light is impaired—a condition known as "night blindness." Unfortunately, changes do not occur in visual adaptation or the plasma vitamin A levels until most of the vitamin A stored in the body has been used up.

Other criteria which have been used in evaluating vitamin A adequacy include resistance to infection and the condition of the epithelial tissue—the cells that form the outer layer of the skin and the mucous membranes that line the mouth and the digestive, respiratory, and genitourinary tracts.

The literature contains reports of controlled studies on the retinol requirements of infants and young adults and on the beta-carotene requirements of adults and children 2 to 5 years old. The amount of vitamin A required by nursing mothers has been estimated from studies on the vitamin A content of human milk. However, there are no reports of controlled studies with adolescents, pregnant women, or the elderly.

Too much vitamin A results in a condition known as "hypervitaminosis A." Numerous accounts of both acute and chronic hypervitaminosis A appeared in the literature from the United States and Western Europe. The severity of the symptoms depended on the age of the subjects as well as the amount and duration of excess intake. Acute cases occurred most frequently in infants 2 to 8 months old. Chronic hypervitaminosis A occurred among people of all ages but was most common among adults. Because excess vitamin A is not readily excreted from the body, the liver is damaged when it receives more of the vitamin than it can safely store. Continued excessive intake causes tissue damage throughout the body.

Existing data suggest that a person's dietary vitamin A requirement depends partly on the availability of the provitamins from food. Other important factors are the body's ability to absorb and transport the available provitamins and to convert them to retinol.

The ARS study shows that progress in research on human dietary vitamin A requirements has been slow because scientists have not had sensitive methods for determining the amount of vitamin A that the body needs for all of the cells to function properly. They have also lacked methods for estimating the amount of vitamin A used daily and the amount that is stored in the body. Hopefully, recent technological advances, when applied to the search for vitamin A data, will enable scientists to learn more about man's dietary needs for this vitamin. □

Architecture

THE PROTEIN STRUCTURE of certain American soybean varieties makes them superior candidates for the production of kori-tofu—a dried soybean curd popular in the Japanese diet.

Traditionally made from Japanese and Manchurian beans—about 40,000 tons of them annually—kori-tofu has been the product of a complicated, unsystematic manufacturing process. Recent ARS-sponsored research in Japan has changed this. The purpose of this Public Law 480 study was to standardize the manufacturing process and to find a U.S. soybean variety that would substantially improve the end product.

Dr. John C. Cowan, ARS chemist and sponsoring scientist, Peoria, Ill., says the Japanese succeeded in both aims and, in addition, provided the groundwork for certain future soy protein research. "The essential production points include rapidly chilling fresh tofu to 14° F. in 1 to 2 hours and then holding at 26–29° F. for 3 weeks. Hawkeye was judged the best variety for making kori-tofu; it rated high in yield, color, brightness, and spongy texture," Dr. Cowan said.

The desired spongy texture of kori-tofu develops during storage at temperatures just below freezing. Rapid initial freezing to 14° F. has the effect of lowering the number of contact points be-

# of Soy Proteins

tween the soy protein molecules. These fewer contact points lead to the formation of fewer disulfide (—S—S—) bonds during subsequent storage at near freezing temperatures. The formation of the —S—S— bonds at the contact points makes crosslinks that contribute to the spongy network characteristic of kori-tofu.

Dr. Cowan says the origin of these —S—S— bridges in this process is the result of either the interchange reactions between sulfhydryl (—SH) groups, which are always present in soy protein, and existing —S—S— bonds or oxidation of two —SH groups in neighboring protein molecules.

For making good kori-tofu, the ratio of 7S to 11S proteins has been considered an important key. The "S" stands for Svedbergs, a unit of sedimentation rate in ultracentrifugal measurements for determining molecular weights and other properties. In proteins, this unit can have values of 1S to 200S; in soy proteins, the major components have sedimentation rates of 7S and 11S.

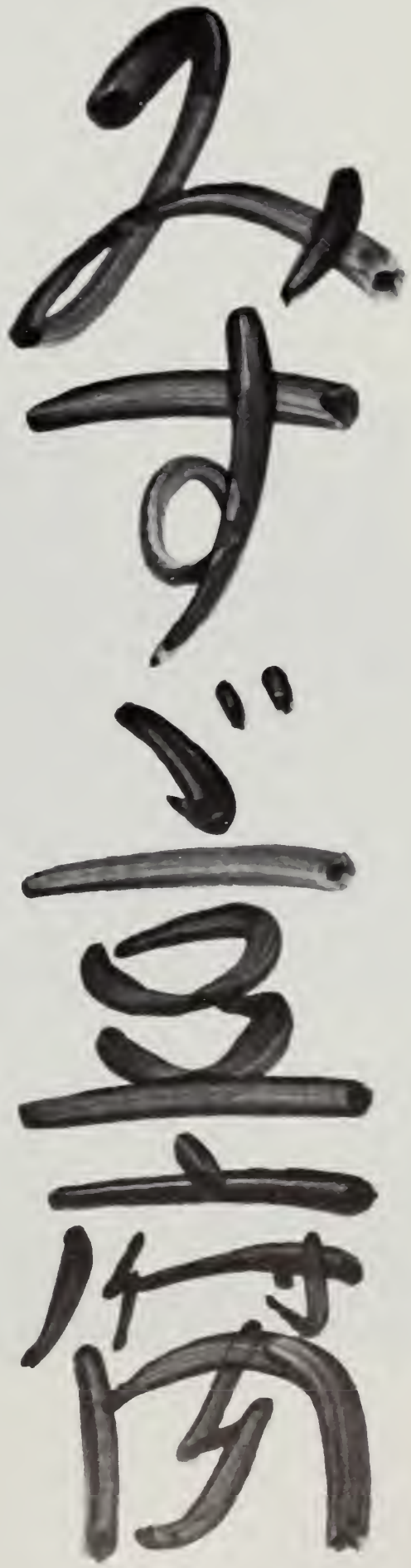
ARS chemist Walter J. Wolf and his colleagues at the Northern marketing and nutrition research division, Peoria, were first to show that the ratio of 7S to 11S proteins differs among soybean varieties. This basic work provided explanation for Japanese observations that some soybean varieties are better suited for making tofu than others.

The Japanese found that the 7S component makes a softer tofu than 11S, which is a larger molecule. The smaller, lower molecular weight 7S protein component is more readily made insoluble by freezing than the 11S, because the 7S component has more readily available —SH groups, precursors of the —S—S— bonds. The protein apparently becomes insoluble by forming these —S—S— crosslinks. However, the presence of a definite ratio of 11S molecules in the tofu is necessary for the desirable firm consistency of the end product.

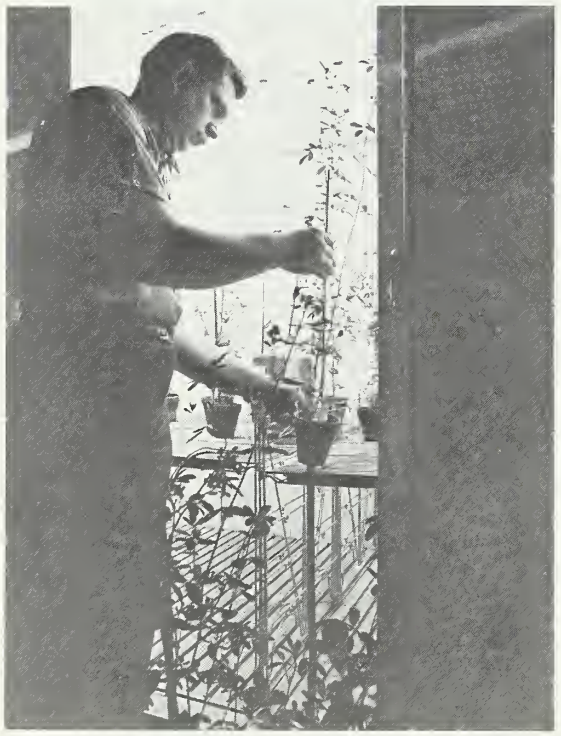
"Future work," Dr. Cowan said, "will be required to determine the exact optimum ratio, but the Japanese project has proven the importance of this protein ratio to the production process."

The Japanese project was conducted by the Japan Frozen Tofu Association, Tokyo, under the direction of principal investigator, Dr. Yosito Sakurai. □

Recently, Beeson, an American soybean variety genetically related to Hawkeye, has come into use for making tofu because of its higher yield per acre.



Right: *Dr. Robert K. Howell inspects rooting of alfalfa cuttings. Selection cycle starts and ends with this procedure—cuttings from alfalfa plants used in selection are reproduced by vegetative propagation and put through the fumigation and selection process. Final step includes taking cuttings from tolerant and resistant plants to send to cooperators who will do further research (0471X379–17).*
Below: *After cuttings are grown, Dr. Howell places them in fumigation chambers where air mixed with controlled amounts of ozone is added (0471X379–25).*



Plants that resist pollution

AIR POLLUTION, a serious stress factor affecting plant growth, is responsible for $250 to $500 million worth of plant losses annually in the United States. Until air is made cleaner, ARS plant scientists in several disciplines will approach the problem by making plants stronger.

"Scientists in many fields have been forced into the position of doing some crisis-inspired research in relation to pollution," explains ARS plant pathologist Howard E. Heggestad, director of the Plant Air Pollution laboratory at Beltsville, Md. "Whenever possible, we like to get a few steps ahead of crises. A major purpose of our work is to provide sources of plant air pollution resistance for use by plant breeders when they synthesize new varieties."

A recent development illustrates how facilities, people, and their skills are merged to result in a pollution-resistant alfalfa. The result was the release of alfalfa clones or strains resistant to ozone. These clones are available to scientists throughout the United States for research and development.

Team, an alfalfa variety released in 1969, has now been shown to have ozone tolerance. It was developed by ARS plant breeder Clarence H. Hanson and coworkers, in cooperation with scientists at the Agricultural Experiment Stations of North Carolina, Virginia, and Maryland.

The original project, started in 1957, was aimed at developing resistance to alfalfa weevil and other plant pests and diseases of this vital forage crop. As one criteria for selection, plants that showed foliar injury were discarded.

When selection work went from fields in North Carolina to greenhouses at Beltsville, Team showed less leaf damage than other varieties. Increased resistance to air pollution was suspected as the cause for reduced damage, so experiments were designed to determine if this was true.

ARS plant pathologist Robert K. Howell, in charge of this phase of the investigation, and geneticist Thomas E. Devine fumigated some plants with ozone while others were exposed to ambient air—filtered or unfiltered in the greenhouse, or in the field.

The suspicion was upheld. Team, the

Left: *Geneticist Thomas E. Devine and Dr. Howell score and record ozone injury to alfalfa plants in the greenhouse (0471X381–5).*
Below: *Visual evidence of ozone damage: left, leaves from a healthy alfalfa plant; right, leaves from an alfalfa plant exposed to 120 pphm ozone for 4 hours (0471X381–17).*

product of years of selection for, among other things, healthy looking foliage, was also more resistant to damage from ozone than varieties that hadn't gone through a similar selection process.

At this point, plants with contrasting responses to ozone were selected, retested in different environments, and propagated by cuttings. The cuttings with known histories of ozone response are available for further research, but the story is far from over.

These selected plants can be used by alfalfa breeders to develop new varieties to reduce production losses from air pollution. They serve as effective tools for monitoring environmental stresses. Essentially, these clones offer many research opportunities for plant breeders, geneticists, physiologists, pathologists, and extension personnel before they are finally released to growers.

Identification of Team as ozone resistant illustrates how scientists of many research disciplines work together to reach a common goal. Dr. Heggestad explains that even where air pollution may not pose an immediate threat, ARS work is building toward the future. □

Above left: *To obtain the most suitable strain of fish for use in mosquito control operations, Dr. James Hoy breeds* Gambusia *selected for fast prolific breeding and adaptability to handling in mass rearing operations (0371X218–19).* **Below:** *Mortality of* Gambusia *minnows was minimal in test drops at various speeds and heights above rice fields in related experiments conducted by the Kern County Mosquito Abatement District in cooperation with Dr. Hoy (0871K1015–18).* **Above right:** *Dr. Hoy places fish traps in rice fields where periodic samplings were taken to establish an absolute population estimate (0871K1013–14).*

MAKING A MEAL OF MOSQUITOES

Minnows that dine on mosquito larvae may have sufficient potential as biological control agents to warrant their commercial production and distribution.

Known as mosquito predators for about 50 years, *Gambusia affinis* minnows have been used for mosquito control in some areas. Scientific information has been lacking, however, on costs and large-scale operational conditions under which they would be most effective.

These questions are now being answered in field experiements near Robbins, Calif., by ARS entomologist James B. Hoy in collaboration with Eugene E. Kauffman, manager, and Allan G. O'Berg, mosquito control specialist of the Sutter-Yuba Mosquito Abatement District in California. *Gambusia* minnows released at an annual rate of 300 fish per acre achieved good control of mosquito larvae over 2,017 acres of rice. These results are consistent with earlier small-scale tests made to determine the minnows' potential (AGR. RES., Jan. 1971, p. 14).

The experiments enabled Dr. Hoy to project cost estimates that hold promise for eventual economical commercial application of the minnows over large areas. ARS contracted with a private aquiculture laboratory to refine mass-rearing operations that could bring production costs to 60 cents per acre, if minnows were released in quantities of 300 or more per acre.

Costs for 1,000 acres would be about $1,040, including the use of helicopter at $120 per hour to distribute the fish.

In contrast, the cost for insecticides and airplane rental to control California mosquitoes runs about $2,200 for 1,000 acres, not counting labor.

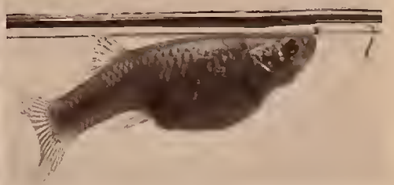
Some control districts spray rice fields as many as 12 times a season; in contrast, the Robbins tests indicate that one annual release of minnows would be sufficient. Although some progeny survive from one year to the next, rice production practices would require annual restocking of *Gambusia* minnows to develop the large numbers needed at the critical time of mosquito buildups.

In the test area, rice is planted from late April until mid-May and minnows are released 1 to 3 weeks later. Female minnows ready to spawn are selected for release. The first brood of these fish produce offspring that account for the major effect against mosquitoes, as both prey and predator hatch in large numbers at about the same time.

Additional broods of *Gambusia* are produced at 3-week intervals, adding to the pressure on the mosquitoes during the period most favorable to their development. Tests indicate that the *Gambusia* population in rice fields stabilizes at 5,000 to 10,000 fish per acre.

In addition to potential economic and ecological benefits from *Gambusia*, the entomologists noted a health factor. Although most mosquito species are known as an annoyance at worst, the two species found in the test area are potential bearers of human disease organisms. One species, *Culex tarsalis*, is a potential spreader of encephalitis, and *Anopheles freeborni* may spread malaria—disease risks that might be minimized by *Gambusia* minnows. □

Above: *Dr. Hoy and technician Terrell Tucker examine fish taken from traps to determine how uniformly the minnows disperse over the rice paddy. These fish will be taken back to the lab where they will be counted and measured. Because of the design of the trap, only females are captured, as the smaller males escape through the mesh (0871K1014–7).* **Below left:** *Dr. Hoy and Mr. Tucker determine effectiveness of minnows in test area by counting mosquito larvae by species and stage of development (0871K1010–3).* **Below right:** Gambusia affinis *(0371X218–15).*



NEMATODES stunt grass growth

UNTIL NOW, nematodes—tiny, parasitic worms—weren't considered a very serious or widespread problem in lawns and turfgrass outside warmer sections of the country. However, ARS plant scientists have not only tied some cool-climate lawn damage to soil-inhabiting nematodes, but have successfully treated the damage.

Nematodes are responsible for upwards of $1.5 billion in crop damage annually. This is primarily concentrated in relatively warmer regions with high soil and air temperatures and long growing seasons—also ideal conditions for nematodes.

ARS nematologists Julius Feldmesser and A. Morgan Golden inspected eight lawns in the Washington, D.C., metropolitan area that had large, "burned out" patches, which were spreading. High temperatures increased the symptoms, but extra water and fertilizer didn't help. All of the lawns contained Meyer zoysia and one had Kentucky bluegrass as well.

Soil and root samples from damaged and undamaged sections of each lawn were analyzed. Damaged sections showed heavy infestations of a combination of plant-parasitic nematodes. Undamaged sections had one or two types not harmful to plants or had very low populations of the plant-parasitic forms.

Next, the scientists tested the effectiveness of *O*-ethyl *S,S*-dipropyl phosphorothioate. This experimental chemical has known nematicidal activity, is not toxic to most plants, has relatively long residual activity in the soil, (6 to 9 months) and has relatively low toxicity to mammals.

The chemical was applied as 10 percent granules at the rate of 20 pounds per acre (active) with a fertilizer spreader or seed spreader and immediately watered down into the root zone.

Within 2 to 4 weeks after application, damage symptoms stopped spreading and started to diminish. During the second month after treatment, bare spots filled in, grass became a deeper green color, and growth increased.

Root and soil samples after treatment showed sharp reductions in nematode populations compared with pretreatment and untreated check samples.

These results indicate that plant-parasitic nematodes must be considered as significant growth-limiting factors in turf and lawn management in cooler climates as well as in warmer regions, Dr. Feldmesser and Dr. Golden explain.

Applications of effective nematicides may be worthwhile in areas where high nematode populations occur, and these results underline the importance of safe, long-lasting, chemical control for home lawns.

The nematicide is not now registered for use around the home. Before a chemical can be released to the public, it must undergo stringent tests by its manufacturer, who then submits test data and the product to the Federal Government for evaluation and registration. □

Flushing the salt from the soil

INTERMITTENT FLOODING could help solve a lot of problems for those irrigators with saline soil problems.

ARS field studies in the Imperial Valley of California show that the method is more efficient for leaching salty soils than either conventional continuous ponding or continuous sprinkling. All three methods leached 60 percent of the salt from the soil in 65 days, but intermittent flooding used only 1.6 feet of water as compared with 2.6 and 3.0 feet used by continuous sprinkling and continuous ponding, respectively.

Normally, saline soil is reclaimed by ponding water on the bare soil surface for several months. Considerable earthmoving is necessary to keep 2 to 3 feet of water on the field during leaching. Leach water passes down through the soil, dissolving and carrying the excess salt below the root zone. After leaching, the land must be releveled before irrigation can continue.

Continuous sprinkling is a relatively new method that involves setting up solid-set sprinkling systems that run continuously during the leaching period. The method involves leasing or purchasing the sprinkling equipment, continuous pumping, and removing the equipment after the leaching operation.

Intermittent flooding, using 2 to 4 inches of water on a field and keeping it wet about 60 percent of the time, needs no extra land preparation and can be done before or after the cropping season or, in some instances, while the crop is growing.

Comparative per acre costs of the three methods are $21.60 for intermittent flooding, $78.45 for sprinkling, and $66.40 for continuous ponding.

The best management of soil salinity is to prevent excess salt from accumulating in the soil by using enough water at each irrigation—usually 10 percent more than needed for evapotranspiration—to remove the added salt. Salt accumulates because plants take up water but not salt. That, coupled with evaporation removing pure water to the atmosphere, leaves all the salt in the soil.

Although techniques are changing (AGR. RES., Mar. 1970, p. 12), irrigation is still more of an art than a science. It is difficult for irrigators to know how much excess water to put on land without precise knowledge of water use by plants under various conditions of temperature and humidity.

That's where intermittent flooding comes in. The method puts enough water on the land to leach out salts and to keep them at a low level, while using much less water than other methods—sort of preventative maintenance.

Studies are continuing under the guidance of ARS agricultural engineer Lyman S. Willardson, Brawley, soil scientist James D. Oster, and agricultural engineer Glenn J. Hoffman, Riverside, with the cooperation of the California Agricultural Experiment Station, Davis.

While intermittent flooding and sprinkler techniques are not new ideas for efficient leaching, the studies have demonstrated on a field scale that these practices are feasible and manageable. □

Below: *The extensive earthmoving necessary for continuous ponding can been seen here in the Imperial Valley, Calif. After leaching is completed the land must be releveled before irrigation can continue (PN–2792).*

Above: *Common bunt spores are released as harvester passes through wheat field (BN–20676).* **Right:** *Wheat plant at right is healthy; plant in center is infected with common bunt; while plant at left is infected with dwarf bunt, which may reduce stem length by half (BN–39239).*

New bunt control for winter wheat

DWARF BUNT, a serious and spreading disease of winter wheat in the Pacific Northwest, may be brought under control with chemical seed treatments now in the advanced experimental stage.

Bunts (common and dwarf) are fungus diseases which may destroy the grain and contaminate food made from the wheat. Annual losses totalling millions of bushels have occurred, explains ARS plant pathologist James A. Hoffman, Pullman, Wash.

While common bunt has been nearly eliminated with an integrated approach using resistant wheat varieties and chemical seed treatment, dwarf bunt has not been controlled by these methods and has become increasingly important as a disease of fall-sown wheat.

While plant resistance is the most desirable disease-control method, new races of the pathogens which will attack existing plant varieties continually evolve, so chemical treatments are a necessary adjunct to varietal resistance.

Dwarf bunt, while not as prevalent as common bunt, presents the more pervasive problem. Common bunt spores survive for just one season, then die. Dwarf bunt spores may remain viable in the soil for 7 or 8 years, or even longer. When conditions are right, spores at the soil surface germinate, infecting the wheat plants.

Dr. Hoffmann evaluated several fungicidal seed treatments and sprays at locations in Pullman, Wash., Flora, Ore., Cavendish, Idaho, and Kalispell, Mont., in cooperation with the Agricultural Experiment Stations in those States. "Screening of fungicides that control cereal diseases expanded because of the restrictions on mercury use." Dr. Hoffmann said. "However, mercury was not used as a seed treatment in the Pacific Northwest even before the ban."

The systemic fungicide thiabendazole, [2-(4-thiazolyl)-benzimidazole] proved effective in controlling dwarf bunt when applied as a slurry to the seed at the rate of 2.4 ounces per bushel. Compared with the alternative—soil treatment—seed treatment has the advantage of requiring small amounts of chemical material and a relatively simple application method.

Seed treatment with thiabendazole at 1.2 ounces per bushel provided control of seed- and soil-borne common bunt. At 2.4 ounces per bushel, the chemical was effective against dwarf bunt under most experimental conditions.

Effectiveness against dwarf bunt varied with seeding date and test location. Results at Pullman indicated that the later the seeding date, the greater the bunt control. Results at other sites indicated that control may depend on amount of seedling growth before infection. However, as Dr. Hoffmann points out, "No other seed treatment has been shown to be effective against dwarf bunt."

Additional studies are needed to determine if thiabendazole would in any way adversely affect the environment.

The fungicide is not registered for any of the uses evaluated in these experiments. Before a chemical can be released to the public, it must undergo stringent tests by its manufacturer, who then submits test data and the product to the Federal Government for evaluation and registration. □

How long will our dams last?

SCIENTISTS have found a way to predict the useful life of certain reservoirs and lakes as governed by sediment buildup: reading the record etched by fallout.

In studies of four reservoirs, they are utilizing the fallout of radionuclide cesium 137 from peak years—1959 and 1963—to date and trace the movement of sediment that has been deposited in the reservoirs since 1959. Sediment is the number one pollutant of the Nation's waters.

Cesium, like some other radionuclides, was introduced into the atmosphere with the advent of the nuclear age. Within small regional watersheds, fallout cesium 137 was uniformly distributed on the surface soil and tightly adsorbed to surface soil particles. Some of these "tagged" soil particles then move through the sedimentation cycle and may be used to date sediment profiles at the bottom of reservoirs and lakes. The "tagged" particles end up as two distinct layers on the bottom of the reservoir. The deposition between the layers and that on top of the last "tagged" layer can be used to tell how fast the impoundment is filling with sediment.

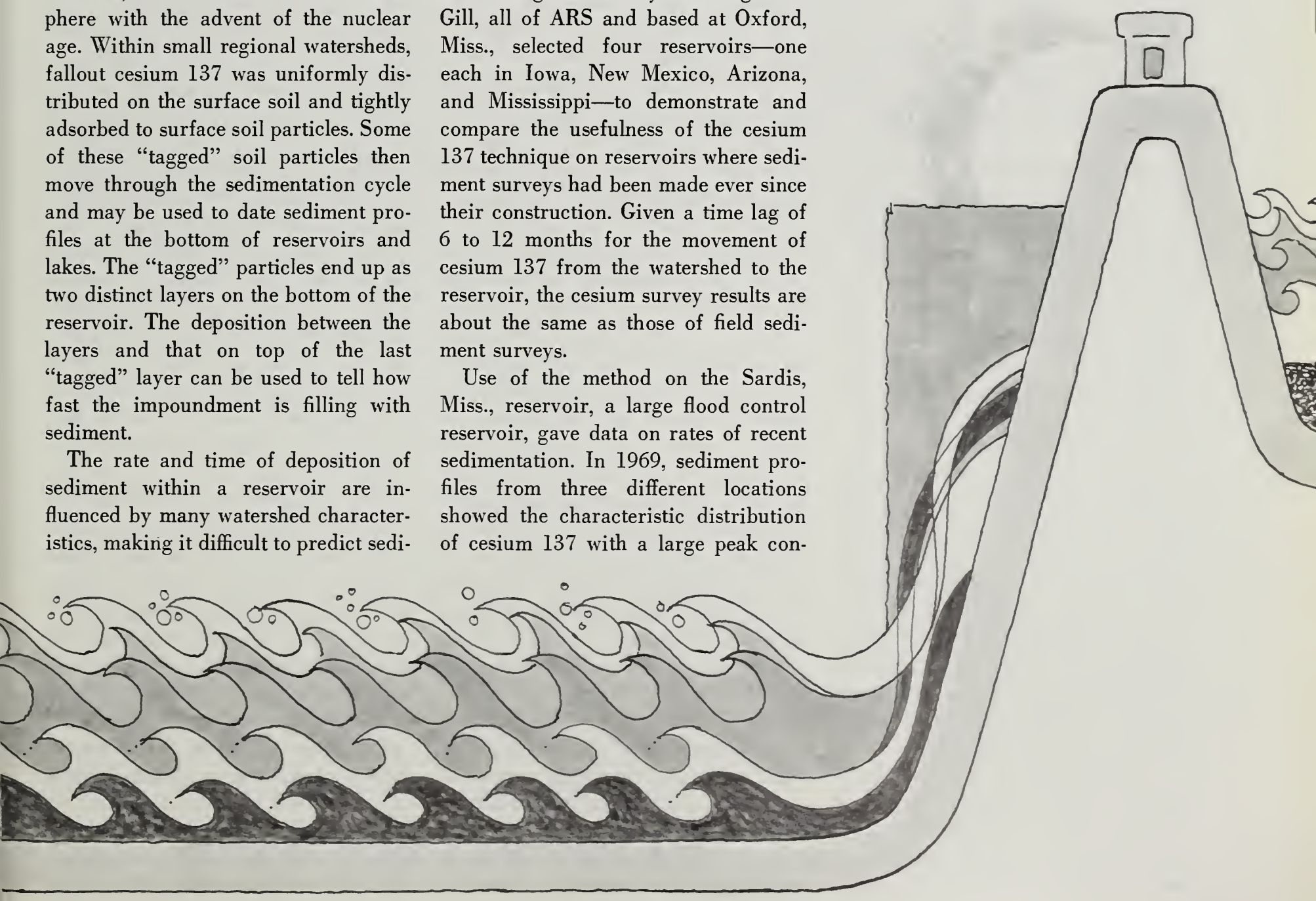
The rate and time of deposition of sediment within a reservoir are influenced by many watershed characteristics, making it difficult to predict sediment rates in a particular reservoir. Geologic sediments have been dated by radiocarbon and by other natural radionuclides, but determining recent sedimentation rates involves the survey and subsequent resurvey of reservoirs, a time-consuming and expensive method.

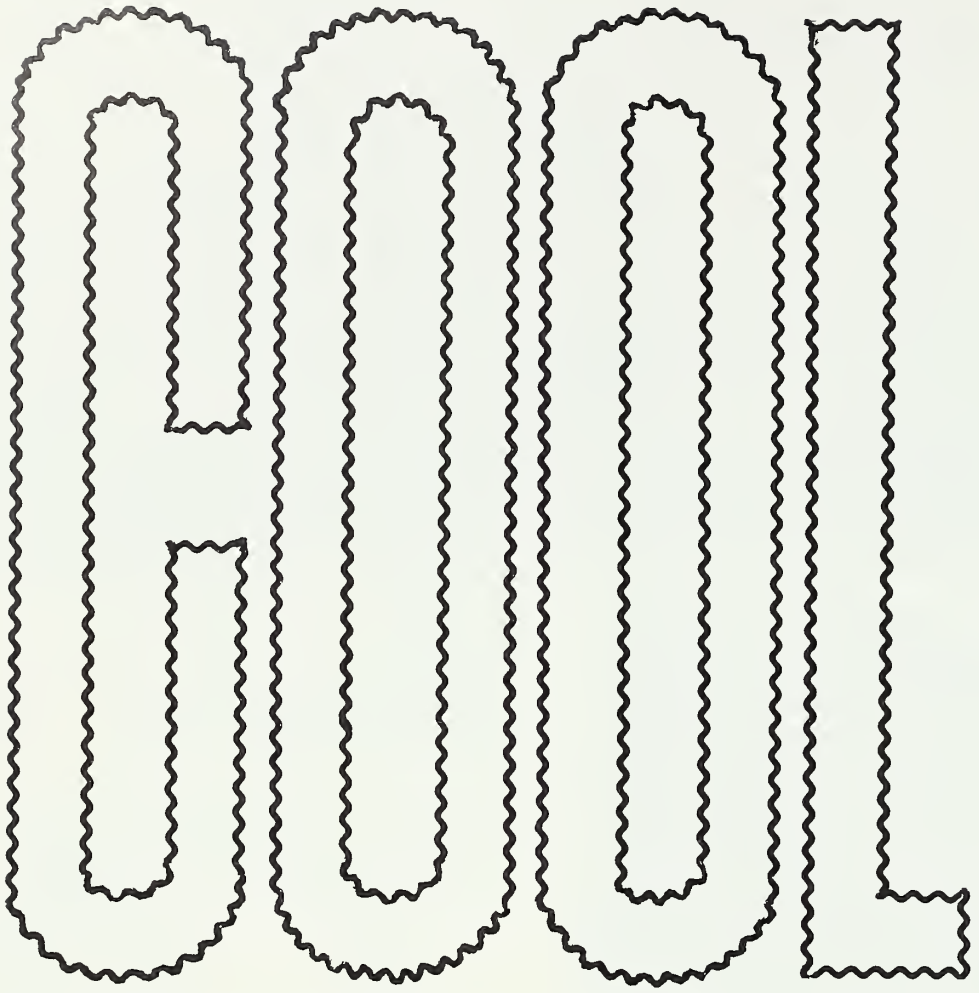
The cesium 137 method, proven by comparing it with data from reservoirs with a known sedimentation history, could save time and money and be valuable in dating reservoirs that have never been surveyed.

Botanist Jerry C. Ritchie and chemists J. Roger McHenry and Angela C. Gill, all of ARS and based at Oxford, Miss., selected four reservoirs—one each in Iowa, New Mexico, Arizona, and Mississippi—to demonstrate and compare the usefulness of the cesium 137 technique on reservoirs where sediment surveys had been made ever since their construction. Given a time lag of 6 to 12 months for the movement of cesium 137 from the watershed to the reservoir, the cesium survey results are about the same as those of field sediment surveys.

Use of the method on the Sardis, Miss., reservoir, a large flood control reservoir, gave data on rates of recent sedimentation. In 1969, sediment profiles from three different locations showed the characteristic distribution of cesium 137 with a large peak concentration in the upper part of each profile and a smaller, yet significant, peak lower in each profile. By associating these peaks with periods of maximum fallout (1959–60 and 1963–64) it is possible to date each profile. Then, by knowing the approximate dates for each profile, sedimentation rates can be calculated. Sedimentation rates for 1964–69 were 3/8, 3/4, and 1 1/4 inch, respectively, for each sample. Rates for 1960–64 were approximately 1 1/4, 3/4, and 1 1/4 inch, respectively, for the same samples.

The sedimentation rate has remained almost constant at Sardis since 1960 for these three sites. By knowing the approximate sedimentation rates, at sufficient locations within a reservoir, estimates can be made of what the future of the reservoir will be. □





heifers keep regular cycle

TRANSFERRING HEIFERS from cold to hot climates just before the breeding season could delay the time to conception, and feeding barren heifers costs the producer extra dollars.

Cessation of the estrous cycle and other marked physiological changes in cattle may result from the sudden exposure to high temperatures. However, cattle can adapt to the higher temperatures given time and the proper diet.

The effects of heat stress were studied by ARS cattle scientists James Bond and Robert E. McDowell, Beltsville, Md. Both summer- and winter-conditioned heifers were used in four winter and two summer trials.

Cattle maintained outdoors during the summer or winter were subjected to 90° F. temperatures in climatically controlled chambers. Control cattle were kept in conventional barns.

The heifers received a pelleted high-energy, low-fiber diet and water in trials lasting from 56 to 200 days. They were allowed to consume as much as they wanted. Weekly measurements were made of hair coat depth and weight, and daily checks were made for estrus.

Only one summer-conditioned female out of six ceased normal estrous cycling, but 18 winter-conditioned females ceased cycling for periods of 56 to 112 days. Estrous cycle appeared related to the degree of stress—the difference between winter and high summer temperatures.

To further test this relationship, six summer-conditioned heifers were placed in the chambers during August the following year and were subjected to temperatures of 100° F. Initially, their body temperatures rose, then declined slightly, and leveled off. During the 6-week period, all but one of six heifers ceased to cycle.

Though winter-conditioned heifers ceased cycling for various periods of time, they conceived and bore normal calves once regular cycling began.

Other changes in heat-stressed heifers included an average increase of 52 respirations per minute, an average temperature increase of 1.8° F., and a 13-quart increase in water intake over conventionally housed heifers.

The most dramatic physical response to heat stress was shedding and decreased hair coat depth in winter-conditioned females. In summer-conditioned females there was no distinct hair loss. Hair coat depth seemed to be most closely associated with adaption of the heifers to constant heat stress.

The scientists found that feeding the high-energy, low-fiber diets and giving the heifers plenty of water helped them adapt to the higher temperatures. The high-energy, low-fiber feeding regime should be kept in mind by producers moving cattle from low to high temperatures, because high-fiber diets produce more body heat during digestion.

Dr. Bond says that prior climatic conditioning is important in the heifer's response to heat. If possible, it is best to buy cattle in one's own climate region. This is especially important during the breeding season. □

Feeding insects the peel

TESTS SHOW that oils from lemon, grapefruit, lime, kumquat, and tangerine peels are highly toxic to cowpea weevils and moderately toxic to rice weevils.

Components of natural food products are a prospective source of effective but nonharmful materials for protecting crops between harvest and consumption by man or animal. Using citrus peel—a byproduct of citrus fruit processing—to effectively control such insects as the rice weevil, one of the most important stored-product pests, would be a welcome addition to the growing ranks of natural insect control methods, and another use for an agricultural byproduct.

ARS chemist Helen Chien-Fan Su, entomologist Roy D. Speirs, and technician Patrick G. Mahany, Savannah, Ga., extracted oil from the peel's outer layer, which contains the oil sacs. Lemon oil and grapefruit oil proved most effective against the rice weevils and cowpea weevils, killing 75–100 percent of the exposed adult weevils at the dosages tested.

Thin-layer chromatographic analyses and topical applications to the insects showed that the lethal component of the lemon peel was not a residue of the insecticides and acaricides generally used as preharvest treatments, nor of the fungicides used as postharvest treatments.

The next step is to isolate and identify the components in the oils and further evaluate their application in controlling insect pests.

Symptoms linked in rare diseases

A RARE chronic nervous system disease of old dogs closely resembles a rare disorder of children.

The childhood disease, subacute sclerosing panecephalitis or SSPE, is produced by measles virus which seems to exist unnoticed in the brain for many years until it flares up and produces a fatal neurological disease. This disease is fortunately rare. Measles in most children produces only a mild fever and rash.

ARS virologist John R. Gorham and pathologist Stewart D. Lincoln of the Washington State University College of Veterinary Medicine, Pullman, found a similar-appearing disease in dogs quite by chance.

Dr. Gorham and Dr. Lincoln were investigating distemper—a common disease of young dogs and mink—when Dr. Lincoln was given two older dogs that had old dog encephalitis (ODE). Like the affected children, the dogs became progressively more uncoordinated until several months later they lost consciousness and died.

As part of their investigation, the scientists decided to use brain sections from these ODE dogs for negative tissue as a control on their experiments. However, in addition to the unmistakable ODE changes, they found evidence of the common distemper virus as well. The distemper virus had apparently remained dormant in the brain of these dogs for years before it flared up.

Measles and distemper are caused by viruses of the same family. It now appears they may cause similar fatal nervous system diseases.

Almost all humans have had measles and there are few dogs that have escaped distemper. But what goes wrong in the very rare cases of SSPE and ODE remains a mystery.

Scientists do not know what allows these viruses to remain quietly for years in the brains of humans and dogs. Have the viruses been altered in some way so that they behave differently, or has the immune state of the human and dog been impaired so they cannot handle these viruses in the usual manner? Many unsolved questions on these diseases remain.

Dr. Gorham emphasized that even though the two viruses causing distemper and measles are related, distemper does not occur in man nor does measles occur in dogs.

Root-shoot ratio in sugar beets

STUDIES on sugar beets seem to indicate that the proportion of root size to shoot size is under genetic control, and that nitrogen nutrition produces different effects on the various plant parts.

The commercially usable portion of the sugar beet is the taproot and a portion of the crown. More sucrose is recovered from a given weight of root tissue than from crown tissue. So, sugar beets with a larger root in relation to the crown would be more desirable.

Plant physiologist Freeman W. Snyder and agronomists George J. Hogaboam and Richard C. Zielke, all of ARS at East Lansing, Mich., developed a technique for determining the proportions of root, crown, and leaves through the displacement of a volume of water when different plant parts were immersed in a container of water. Previous to this study considerable variation in the proportions of root to shoot in individual plants had been observed.

Sugar beets were field grown to evaluate root-shoot ratios of individual plants over two generations. The average root-shoot ratios of the progeny

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differed to the same degree as their respective mother beets—suggesting that the root-shoot ratio is under genetic control.

The influence of nitrogen on the different plant parts was also measured. When compared to the low nitrogen treatment, high nitrogen increased average root volume 15 percent, crown volume 89 percent, and leaf volume 41 percent.

The scientists believe that sugar beets selected and bred for higher root-shoot ratios should increase sugar yield per acre.

Crabshells decrease soil acidity

A byproduct of a commercially developed method for disposal of wastes from Alaskan shellfish processing plants has proved a valuable soil liming agent.

The city of Kodiak, seeking an alternative to dumping wastes in the nearest body of water, financed development of a method for extracting protein suitable for animal feed from crab and shrimp wastes. Crabshell residue, after further processing, was evaluated as a liming agent by ARS soil scientists Winston M. Laughlin and Paul F. Martin at Palmer. The Institute of Agricultural Sciences, University of Alaska, cooperated in the studies.

The processed crabshell contained the equivalent of 58.2 percent calcium carbonate. Dr. Laughlin and Mr. Martin used five different application rates (1–5 tons per acre) on strongly acidic Kachemak and Nancy silt loam soils.

Each additional increment of crabshell progressively decreased soil acidity. Reduction of acidity was greater at each rate in the Nancy soil than in Kachemak, which has a higher organic matter content and somewhat finer texture. Finer (100- and 50-mesh) particle size was more effective than coarser 10-mesh and the original particle size.

The scientists planted romaine lettuce 11 months after application of crabshell to the soil. No significant difference in lettuce height was found for rates lower than 5 tons per acre until the fifth week, when the 4-ton rate produced significantly taller plants. The 5-ton rate produced three times more lettuce than when no liming material was used.

Unit shipping saves time and money

UNITIZING the shipping of groceries from warehouses to retail stores could save approximately $170 million per year in food distribution costs by increasing employee productivity.

Independent grocery retailers must get a maximum dollar output per dollar input if they are to continue competing with the corporate retail grocery chains.

ARS marketing specialist Jack L. Runyun, Hyattsville, Md., coordinated a study measuring and comparing the efficiency of unitized grocery product shipping with conventional grocery shipping from the warehouse storage area to the retail sales floor.

With the unitized method, 40 or more cases of groceries are placed on a cart with wheels (or on a pallet) as orders are selected at wholesale warehouses and handled as a unit until they reach retail store shelves. With the conventional method, four-wheel hand trucks are used for order selection and transportation to the wholesaler's truck loading dock. At the truck loading dock, cases are loaded individually into the delivery truck. Once at the retail store, grocery cases are unloaded individually from the truck, transported by two-wheel hand trucks to a temporary storage room, and finally transported from the temporary storage room to the shelves on the retail sales floor.

The ARS study indicates that unitized handling with mobile carts or pallets cuts overall delivery costs by more than 20 percent compared to conventional shipping costs when delivering 1,000 cases over a given distance.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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